

DO YOU THINK OR DO YOU KNOW?

By Staff Sergeant Travis Y. Johnson

Knowing the answer to the question “Do you think or do you know?” can mean the difference between success and failure during a deployment. What you *think* is something you’ve been told. What you *know* is what you have done or seen. For example, surveying in an underdeveloped nation or nonpermissive environment is not the same as surveying in a peacetime western environment. Successful predeployment training and relief in place (RIP)/transfer of authority (TOA) when arriving in-theater will close the gap between the two and set the stage for successful deployments. The missions may vary a great deal, yet it all comes down to whether or not personnel think they know or actually know successful deployment procedures. While supporting the 130th Engineer Brigade in Iraq, Detachment 8, 412th Engineer Command (ENCOM), United States Army Reserve, was given survey missions that required all of their combined civilian and military backgrounds. This included previous continental United States (CONUS), overseas, and

combat experiences molded into a proven procedure: beginning in predeployment training, continuing through RIP/TOA, and being continually refined during operations in Iraq. This successful deployment procedure involves more than the simple collection of data and can be broken into six steps. The unit—

- Must have the proper equipment for the job (most important).
- Should have training beyond the basic “schoolhouse” understanding of the equipment.
- Must have an understanding of survey principles and be able to apply them to the mission.
- Must know what data collection standards are required.
- Should be prepared for theater-specific issues.
- Should be prepared for changes.

If not managed correctly, all these things (individually or collectively) can lead to mission failure or loss of a Soldier. In-country survey missions should only be done once. Sending a team twice due to mission failure in CONUS just means that time was wasted, but sending Soldiers back out in a combat theater can cost lives.

Tools of the Trade

Total Station

The traditional survey tool is a “total station,” which is a conventional survey system with an instrument usually referred to as a *gun*, plus required prisms, poles, tripods, batteries, and tripod-mounted levels called *tribrachs*. Until recently, the Army version of this set was the Geodimeter® Automated Integrated Survey Instrument (AIS) 444. This instrument is more than 13 years old and



Photo by Staff Sergeant Travis Y. Johnson

Two survey Soldiers take field notes and set up the Geodimeter 5600.

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is no longer used professionally in surveying. To meet mission requirements, Detachment 8 acquired the Geodimeter 5600 Servo Direct Reflex (DR) 200+ with the Trimble® Automated Control Unit (ACU) Survey Controller as the gun. The gun is capable of measuring 5,500 meters to a prism with two-second accuracy over that distance or roughly 5 centimeters. This is a line-of-sight system and was acquired with global positioning system (GPS) gear to be used as a stand-alone system or together. Although not standard military equipment, the United States Army Engineer School, Fort Leonard Wood, Missouri, recently adopted the 5600 gun with a slightly different control module, the Geodimeter Control Unit (CU), which is more closely related to the AISI 444 operational procedures.

Global Positioning System

The GPS acquired to meet mission requirements is the Trimble 5800 Real-Time Kinetic (RTK) Rover. The main component is the Site Positioning System (SPS) 780 Rover series with base option, which is an antenna that can be used as either a GPS base station or as a rover. A rover collects RTK GPS data while moving. The rover vehicle can be any platform, but is typically an all-terrain vehicle like the Polaris Ranger® 4x4, which needs only minor modifications to mount the survey rod. This GPS requires an attachable data collector, the Trimble Survey Controller 2 (TSC2), which can be interchanged with the base, the rover, or the gun. This system measures at an unadjusted accuracy of 1 to 3 centimeters.

Software

The Army trains and supplies Terramodel™ civil design software developed to use with Trimble equipment. Other software supplied and trained by the Army is AutoCAD 2004, but AutoCAD 2004 Land Desktop Development (LDD) and other Autodesk civil design series components are also available. Conversion and data management software packages are required, such as Geotrans V2, Convert 4.08, Trimble Data Transfer, and Trimble Geomatics Office. No single software package could satisfactorily meet all missions; the combination of all this software was essential to the various missions and their changes. Nontechnical but important software in creating a final product is Adobe® Acrobat® Professional, which allows almost any technical output to be made into a portable document format (PDF) that any client can view.

Predeployment Training

Predeployment training is mandatory for all deploying Soldiers. There are core, theater-specific tasks, such as convoy operations, that all services mandate. Military occupational specialty (MOS) 21T technical engineer specialists, like all Soldiers, need to train in their job-specific tasks. However, unlike 21B combat engineers, 21Ts are low-density, and not many qualified and experienced trainers are available. A 21T must be an expert not only in surveying but also in drafting, computer-aided drafting (CAD), soils analysis, concrete quality control, and other critical technical engineer jobs that require considerable training and experience after

the initial schooling (military or civilian). If they only have schoolhouse or basic MOS training, the odds are that they only think they know the job.

A train-the-trainer atmosphere is perfectly suited for correcting this problem. Given sufficient lead time, a 21T trainer from the Engineer School or from a training brigade may be available. Local vendors for survey equipment may be able to provide hands-on training that can be very important. Even a single experienced noncommissioned officer can successfully mentor school-trained Soldiers during predeployment training. It is also important that unit leadership be thoroughly familiar with all the software, hardware, and applications in order to set the missions for success in planning, logistics, and specifications. Finally, advance coordination with the unit being replaced can ensure that “right-seat/left-seat” training (working side by side with someone familiar with the job), using actual ongoing missions, will use the RIP/TOA period to build on predeployment training and bring the incoming unit up to full speed.

General Survey Principles

There are a few general survey principles that need to be reinforced during predeployment training. These principals are proper point coding, site identification, and the location or placement of benchmarks. Errors in these tasks must be caught and corrected on-site, without slowing the progress, or the entire survey could be wasted. Drilling the steps for each principle as a battle drill would ensure the Soldiers’ confidence both in themselves and the equipment.

Point Coding

Proper point coding steps vary with the equipment, but the principle remains the same. Point coding is how the surveyor assigns identifiers to points. Often a 21T other than the surveyor uses the data to develop drawings. There may be multiple surveys, potentially creating confusion with data sets. Some coding conventions will not be read in by the software. You have to know your equipment. Having a key to the codes as part of the job files eliminates whether people know or only think they know the data codes.

Site Identification and Benchmarks

Proper site identification and benchmarks are also important for mission success. Do the surveyors know that they have enough data at the end of a mission or do they only think they have enough? Everything should be collected. Experience shows that projects can expand or become new projects. In-theater, many clients don’t fully understand how to translate their needs into technical requirements that can also result in additional work. Extra data can make a new survey unnecessary. Available benchmarks should be located in all surveys. Benchmarks make project handoff, map location, and accuracy markedly better. Also, proper field notes streamline surveying, data use, and the ability to effectively change in the middle of a mission.



A Soldier stakes off a base station setup, which is a temporary benchmark for the survey.

It is better to have the data and not need it than to need it and not have it. However, time constraints can make it difficult to get these extra details, particularly if the survey crew has to take considerable time on-site working out the details of the survey. A site visit before the survey with all key project members—to include the client, the designers, and the construction supervisors—is essential for mission success. It ensures that the survey leaders can better plan the site work by seeing it, the client's needs are worked out on the ground and understood by all, and data needs are thoroughly understood.

Collection Standards

Do the survey crews know how to perform the survey accuracy standards for the mission? The civilian standard of surveying is much more stringent than that of an average military surveyor, yet those higher standards are required for United States Army Corps of Engineers® or military contract projects that the surveys support. The difference is in accuracy and legality. Civilian surveyors are required to know property laws and geospatial information systems (GISs) and be able to pass licensing exams. In most states, they must have attained a bachelor of science degree. Military surveyors are not held to the same standards. However, in-theater missions can require civilian levels of expertise, and not being able to execute those missions can delay large projects until civilian contractors are available and funded.

Something normally practiced by civilian surveyors, but not by the military, is the use of an Online Positioning User Service (OPUS) for GPS coordinate correction. This system

has been recently set up in-theater and is monitored regularly. The website is www.ngs.noaa.gov. Using this service ensures that the surveyors and designers know that benchmark data is correct rather than only thinking that it is.

Theater-Specific Encounters

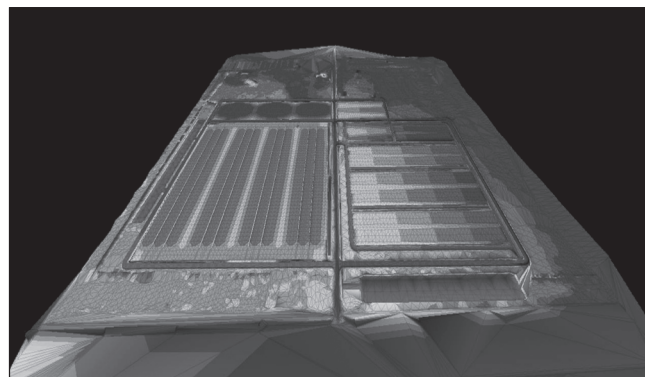
Force Protection

Force protection is always an issue in-theater. The leader for any mission should know the potential threat for the site and for travel to the site. Unexploded ordnance (UXO) could be found on a base where future construction is planned. A route survey can encounter improvised explosive devices (IEDs) and small arms fires. Even secure bases can receive mortar or rocket attacks. These are just some of the challenges survey teams have experienced. Unit planning must ensure that all coordination is made, to include accounting for the amount of equipment being transported for a mission and ensuring

that the security team understands the needs of the survey team. Environmental considerations include high heat, wildlife (such as scorpions and vipers), and cold weather or rain (depending on the location and the season).

Drainage

Drainage is a significant issue in-theater for surveyors as well as for designers. The soils in many of Iraq's populated areas are alluvial silts that seal against water shortly after being wetted instead of allowing water to filter into the ground. The topography of most bases is flat and not conducive to proper drainage. On many bases, gravel is used to "put boots and wheels above the water." This makes the situation worse. Units are in-theater for a year or less and typically do not see the long-term effects. For the surveyor, it may mean recording a point on the top of the gravel and then digging below the gravel to record a point at ground level, both for drainage and



After using a rover-mounted GPS to survey a 1,000-acre site in southern Iraq, a comprehensive drainage plan was developed from the 3-D data using Terramodel.

gravel removal. A site must be designed to drain properly by not draining into another site, which would cause problems there. All drainage structures have to be identified and verified by the surveyor. Whether a site or project will drain properly is something that one must know and not just think they know. Aside from making the area a muddy waste, improper drainage can undermine slabs, roads, and other structures and allow pooling for insect breeding.

Global Positioning System Capability

Several units in-theater have reported a lack of GPS capability. This is in direct relation to them thinking they know the equipment and actually not knowing it. The GPS will likely encounter problems, and a thorough knowledge of the systems is required to fix these problems. Another common issue is GPS elevation variances that do not match the topography across a project. The fix for this is to place multiple base station control points on-site and locate them relative to each other, then use differential leveling within the software package to eliminate the error. A second fix for this problem is to do a "cooked point," which takes at least three hours of data collection in a FastStatic or similar surveying procedure, and send the data files in a receiver independent exchange (RINEX) format to OPUS for correction.

Operations

Equipment Assignment

Proper equipment assignment is important to individual and collective mission success. Does the team leader think he knows all mission requirements or does he really know? Really knowing is a significant challenge. The survey team leader is usually the person who must take the supported unit commander's intent and translate it into technical requirements. For example, a mission may seem to be a perfect application of GPS based on a map reconnaissance; yet once in the field, the line-of-sight gun may be what is needed. The GPS is best-suited for large, open, and unobstructed areas. If there are large concrete buildings or bunkers that block the GPS signal, the gun may be better. Small projects requiring total accuracy are also best-suited to gun usage. The concern about this is balancing whether the unit becomes mission incapable for other missions by sending all equipment to one area against whether a mission can be done with only one. Is there another unit nearby that can help? The United States Army, Air Force, and Navy engineer units can usually help each other if there is advance coordination. Can measurements be taped off and recorded in the field notes instead of using a gun? The mission planner needs to know all resources and methods available to balance current missions against planned missions, as well as any high-priority "short-fuse" missions that may occur.

Mission Creep

Mission creep is how a mission can begin small and become large. Mission creep often occurs when the survey crew thinks they know the mission instead of actually knowing it. Once on-site, the customer usually tries to get additional tasks

completed. There is often a mentality of "I have you here now, and I'm going to keep you," because demand is high for in-theater engineer resources, particularly if the client knows that 21Ts have more skills than just surveying. The team leader must know the mission's scope of work, the commander's intent, the unit's full capabilities, the designers and surveyors, and upcoming missions. Typically, a mission directive will give the team one goal and a specific timeline. Often it's good to do extra work within that timeline, because it provides good will and takes care of the supported unit's missions. Other times, the supported unit's "nice-to-have" want would be at the expense of another mission's "must-have" need. The on-site team leader and the unit's operations section must have a firm grasp of the current and projected workload to balance these priorities.

Changes in Focus

Focus changes are a normal occurrence in theater operations. What the unit may think is their mission is what they were trained on or told prior to deployment. What the unit will know is that their mission is what they will encounter in-theater. This happens across all coalition activities, not just engineering, because coalition governments shift priorities, military missions change, the anti-Iraqi forces change tactics, and engineering priorities change. A survey can be top priority one day, and the next day it can be low priority or canceled. Units being told they will be doing a lot of surveys or few surveys based on current or past Operation Iraqi Freedom cycles may find a different reality on the ground. The only solution is to be prepared and remain flexible. Thinking and knowing is measured on a graduated scale, based on the collection of factual data over time. As such, the facts in-theater will change regularly, and what you know to be the mission today may not be the mission tomorrow.

Conclusion

Surveying in a nonpermissive environment is vastly different than in CONUS. The timelines allowed and the safety considerations put the two environments on different ends of the spectrum. The difference between what you think and what you know of the equipment, personnel, principles, standards, environment, and operations is vital to success in-theater. Soldiers of all ranks need to understand this to ensure that all criteria are met and that all Soldiers return. An improper survey resulting in an improper design can mean lives lost. That is a risk that we, as military surveyors, cannot afford. Ensure that your Soldiers know what is necessary and are prepared for it.



Staff Sergeant Johnson is the Construction Management Section NCOIC for Detachment 8, 412th ENCOM, supporting the 130th Engineer Brigade in Iraq. He has been a United States Army technical engineer for 9 years and a civilian surveyor and civil/mechanical designer for 12 years. He has led military survey missions in CONUS, Korea, Germany, Italy, Kosovo, Bosnia, the Marshall Islands, and Iraq, as well as civilian survey teams in six states.